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P. A. Crowther

CS J= 7 → 6 Mapping of Massive Star Formation Regions Associated with Water Masers

C. Knez, Y. L. Shirley, N. J. Evans II, & K. E. Mueller

Department of Astronomy, The University of Texas at Austin, Austin, Texas 78712–1083

Abstract. 24 cores have been mapped in CS J=7→6 at the CSO. From the spectra we determine core sizes and virial masses. Combining results from the CS and dust continuum studies for M8E, we use Monte Carlo simulations for the CS emission to get radial profiles.

1. Introduction

In order to sample cores in early stages of evolution, Plume et al. (1992, 1997) began a CS survey of H_2O masers associated with star formation regions. H_2O masers indicate high-density regions (n > 10^{10} cm^{-3}) and are believed to be in an earlier stage of evolution than ultracompact HII regions. Because the CS J=7→6 line has a high critical density ($n_{crit} \approx 2.8\text{x}10^7$ cm^{-3}), we can probe the denser parts of the star forming cores. Shirley et al. (2001) have mapped the CS J=5→4 transition ($n_{crit} \approx 8.9\text{x}10^6$ cm^{-3}) which probes slightly less dense gas than the CS J=7→6 line. From the CS spectra, we determine core sizes, virial masses, CS intensities, and radial profiles. Using Monte Carlo simulations for CS emission with the temperatures for given density profiles from the 1-D dust continuum models (Mueller et al. 2001), we can compare the spatial extent of the gas and the dust in the star forming regions.

2. Results from Data

The size of each core was calculated by deconvolving the beam size from the size of the half power contour integrated intensity. Sizes were determined; however, 7 of those sources were not included in the statistics because their deconvolved sizes were less than half of the beam size. About 50% of the cores had deconvolved sizes greater or comparable to the CSO beam which is consistent with a power-law density distribution (Mueller et al. 2001). The virial mass contained within the calculated size was also determined. The CS J=7→6 survey is biased against the highest mass cores observed in CS J=5→4 due to observational exigencies (i.e. they have not been mapped). The average size of the cores was 0.27 ±0.14 pc. In order to compare the virial masses of the CS5-4 and CS7-6 studies, we used the CS5-4 core sizes as our standard (Shirley et al. 2001). The average ratio of the CS7-6 to CS5-4 virial masses is 0.72. This result shows that the emission of CS7-6 is more compact than the CS5-4 emission.

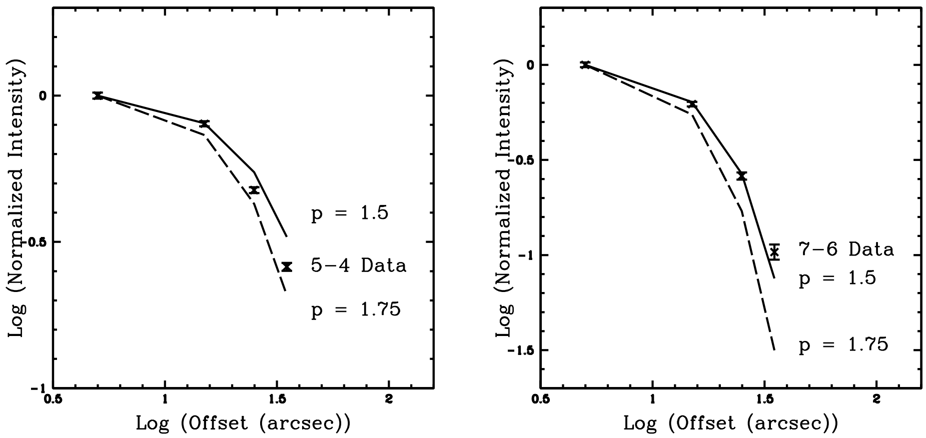

Figure 1. Radial profiles of the intensity of CS5-4 (left) and CS7-6 (right) from the data and the model. The solid and dashed lines represent models with p=1.5 and p=1.75, respectively.

3. Modeling of M8E

The contour map of M8E is roughly symmetrical thus making this source a good candidate for 1-D modeling. The density and temperature profiles were determined from dust models (Mueller et al. 2001). The best fit power law to the dust data was p=1.75. Comparing the density and temperature profiles to the intensity profile for the CS data, we find that the gas seems to prefer a value of p between 1.5 and 1.75 (see Figure 1). This slight disagreement between the dust and the gas can be due to the assumptions in both the dust and gas modeling. For example, we assume a constant molecular abundance but in reality the abundance may vary with radius.

References

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